

# **JEDEC PUBLICATION**

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## **Recommend Practice for Measurement of Transistor Lead Temperature**

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**JEP84A**  
(Revision of JEP84)

**JUNE 2004**

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**JEDEC SOLID STATE TECHNOLOGY ASSOCIATION**



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## **RECOMMENDED PRACTICE FOR MEASUREMENT OF TRANSISTOR LEAD TEMPERATURE**

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### **Foreword**

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This recommendation is intended for use with those transistors where the thermal capabilities are related to the temperature of the terminal leads.

It was originally prepared by the JC-24 Committee on Low Power Transistors and approved for publication by the JEDEC Solid State Products Council of EIA and NEMA.

JEP84 has been revised by the JC-25 committee on Transistors.



## RECOMMENDED PRACTICE FOR MEASUREMENT OF TRANSISTOR LEAD TEMPERATURE

(From JEDEC Board Ballot JCB-04-39, formulated under the cognizance of the JC-25 Committee on Transistors.)

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### 1 Scope

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It is often required to measure the lead temperature of a packaged transistor under various load conditions.

This publication covers recommended methods for the measurement of transistor lead temperatures under various load conditions. The techniques described are sufficiently accurate for most applications.

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### 2 Point of temperature measurement

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The recommended point of lead temperature measurement is one-sixteenth inch (1.5mm) from the case or at a point specified by the manufacturer.

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### 3 Methods of temperature measurements

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3.1 A thermocouple attached to the lead of the transistor with its potential read by a potentiometer *or an equivalent instrument that interprets the temperature directly*.

3.2 A hand thermocouple type pyrometer, such as Alnor Instrument Company's ([www.alnor.com/ipi/pyrocon.pdf](http://www.alnor.com/ipi/pyrocon.pdf)) Type 4000, The Pyrometer Instrument Company, Inc., ([www.pyrometer.com/](http://www.pyrometer.com/)) Model 250, or equivalent.

3.3 Temperature sensitive paint such as Tempilaq<sup>®</sup> or in the solid form such as Tempilstik<sup>®</sup> ([www.tempil.com/](http://www.tempil.com/)), Korthals Therm-o-signal paints ([www.korthals.nl/e/Product/TOSe.html](http://www.korthals.nl/e/Product/TOSe.html)), or equivalent.

3.4 Liquid crystals such as those from Liquid Crystal Industries, Vari-Light Corporation, or equivalent.

3.5 An infrared detector such as Barnes Engineering Company Model RM-2B [supported by Quantum Focus Instruments Corporation (<http://www.quantumfocus.com/>)], Philco Corporation Model 700B, or equivalent.

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\* Trademark of Tempil<sup>®</sup> Corporation

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#### **4 Comment and limitations of each method**

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##### **4.1 Thermocouple - Potentiometer (Range typically 100 °C to 350 °C)**

- a) The error of this technique in degrees Celsius is less than +/- 1% full scale.
- b) This technique permits measurements where the visibility or accessibility of the transistor lead is restricted.
- c) Care must be taken to have solid contact of the thermocouple on the lead surface with minimum deformation of the lead. Attachment by welding or soldering is recommended.
- d) The thermocouple must be shielded from forced drafts.
- e) The heat transfer away from lead due to the attachment of the thermocouple shall be small compared to that through the lead. The thermocouple ball shall be no greater than one-half the lead cross-sectional area.
- f) Excellent reference- ASTM MNL 12, *Manual on the Use of Thermocouples in Temperature Measurement*.

##### **4.2 Hand Pyrometer (Range typically 10 °C to 350 °C)**

- a) The error of this technique in degrees Celsius is less than  $\pm 8\%$  of full scale.
- b) Transistor lead must be accessible during measurement.
- c) This is a relatively quick and simple technique.
- d) This technique is adaptable to measurements of large leads only.

##### **4.3 Temperature Sensitive Paint (Range typically 50 °C to 350 °C)**

- a) The error of this technique in degrees Celsius can be less than  $\pm 1\%$  of the indicated temperature.
- b) The transistor lead must be visible and accessible.
- c) This is a quick and simple technique of ascertaining whether lead temperature is above or below a particular value.



#### **4 Comment and limitations of each method (cont'd)**

##### **4.4 Liquid Crystals**

4.4.1 Broad Range Types (Ranges in degrees Celsius: 50-130, 55-95, 71-171, 114-175 or 126-190)

- a) The error of this technique in degrees Celsius is usually less than  $\pm 5\%$  of the indicated temperature.
- b) The transistor lead must be visible and accessible.
- c) This is a quick and simple technique.

4.4.2 Narrow Range Types (Range of measurement is any 3, 5 or 10 degree range specified between 20 °C – 72 °C, 20 °C – 65 °C, or 20 °C – 70 °C respectively)

- a) The error of this technique in degrees Celsius is usually less than  $\pm 1\%$  of the indicated temperature.
- b) The transistor lead must be visible and accessible.
- c) This is a quick and simple technique.

4.4.3 Memory Type (Range: 30 °C to 60 °C)

- a) The error of this technique in degrees Celsius is usually less than  $\pm 5\%$  of the indicated temperature.
- b) This technique permits measurements where the visibility or accessibility of the transistor lead is restricted.
- c) This is a quick and simple technique of ascertaining whether lead temperature exceeded a particular value.

##### **4.5 Infrared Detector (Range typically 15 °C to 165 °C)**

- a) The error of this technique in degrees Celsius is less than  $\pm 5\%$  of the indicated temperature.
- b) The transistor lead must be visible and accessible.
- c) The emissivity of the lead must be known and compensated for.

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**Annex A (informative) Differences between JEP84A and JEP84**

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This table briefly describes most of the changes made to entries that appear in this publication, JEP84A, compared to its predecessor, JEP84 (February 1973). If the change to a concept involves any words added or deleted (excluding deletion of accidentally repeated words), it is included. Some punctuation changes are not included.

<b>Page</b>	<b>Description of Change</b>
1	Clause 1 Scope – added ‘of a package transistor’.
1	Subclause 3.1 – added ‘or an equivalent instrument that interprets the temperature directly’.
1	Subclause 3.2 – added website addresses.
1	Subclause 3.3 – added website address.
1	Subclause 3.5 – added website address.
2	Subclause 4.1 – added list item ‘f’.



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## Standard Improvement Form

JEDEC JEP84A

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The purpose of this form is to provide the Technical Committees of JEDEC with input from the industry regarding usage of the subject standard. Individuals or companies are invited to submit comments to JEDEC. All comments will be collected and dispersed to the appropriate committee(s).

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1. I recommend changes to the following:

☐ Requirement, clause number \_\_\_\_\_

☐ Test method number \_\_\_\_\_ Clause number \_\_\_\_\_

The referenced clause number has proven to be:

☐ Unclear ☐ Too Rigid ☐ In Error

☐ Other \_\_\_\_\_

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2. Recommendations for correction:

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3. Other suggestions for document improvement:

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